
NREL's Trough Workshop

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Incline Village, NV

**Need for Regulatory Revisions to Successfully Secure
CSP Projects in the US: Lessons from Spain**

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A Brief Look Back: the California Success Story in the 1980'ies

- **Back to the roots:**

- The high oil prices in the early 1980-ies created a boost for renewable technologies
- CSP was capable to respond with firm, dispatchable peaking power
- This energy economic background is back – and the technology is more mature now!

- **The Framework in the 1980-ies:**

- Favorable FERC Regulation
- Investment Tax Credits
- Attractive time-of-use tariffs:
 - 14 US cts. / kWh on the average
 - up to 36 cts. for summer on-peak

- **The Result:**

- 9 plants with accumulated 354 MWe solar capacity built in only 7 years
- 1.2 billion US \$ invested; all private capital (30-40% equity)
- 13 TWh (9 TWh pure solar) produced;
- Electricity sales: \$ 1.8 billion kWh until today



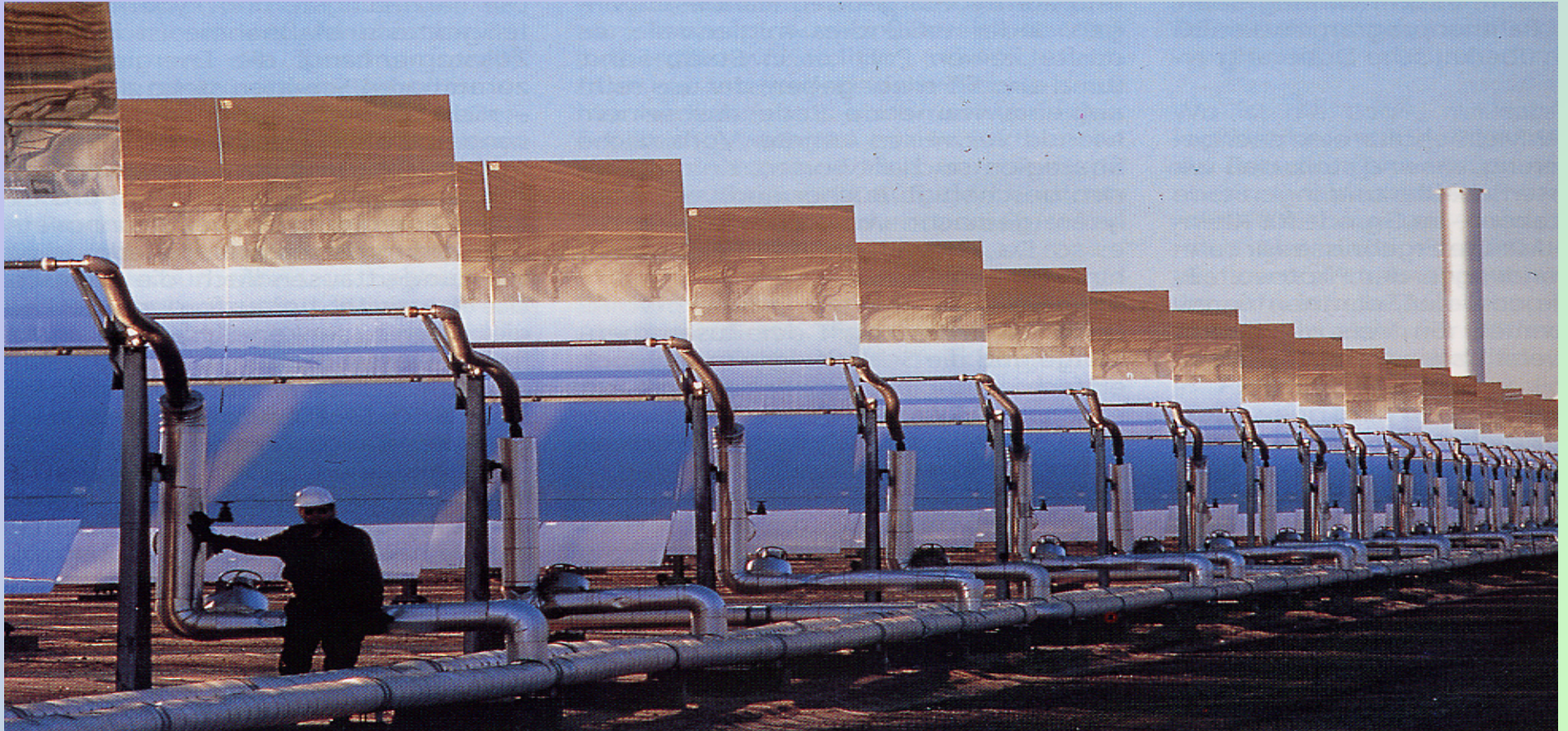
Parabolic Trough Solar Thermal Electric Plants in the California Mojave Desert - German Industry participated in all 9 SEGS plants with 354 MW





Back in 1988, Pilkington/Flachglas' subsidiary FlagSol teamed-up with LUZ for joint project development in Brazil, Morocco, India and Italy. LUZ vanished, Pilkington stepped-out after 8 yrs w/o new projects but Solar Millennium entered the business with private investors in 1999





Solar Millennium concentrated on parabolic trough project developments in Spain and Greece and, most importantly, on regulation and technical improvements and qualification

Results: In 2002 the Spanish Feed-in Law passed, further improved in 2004;

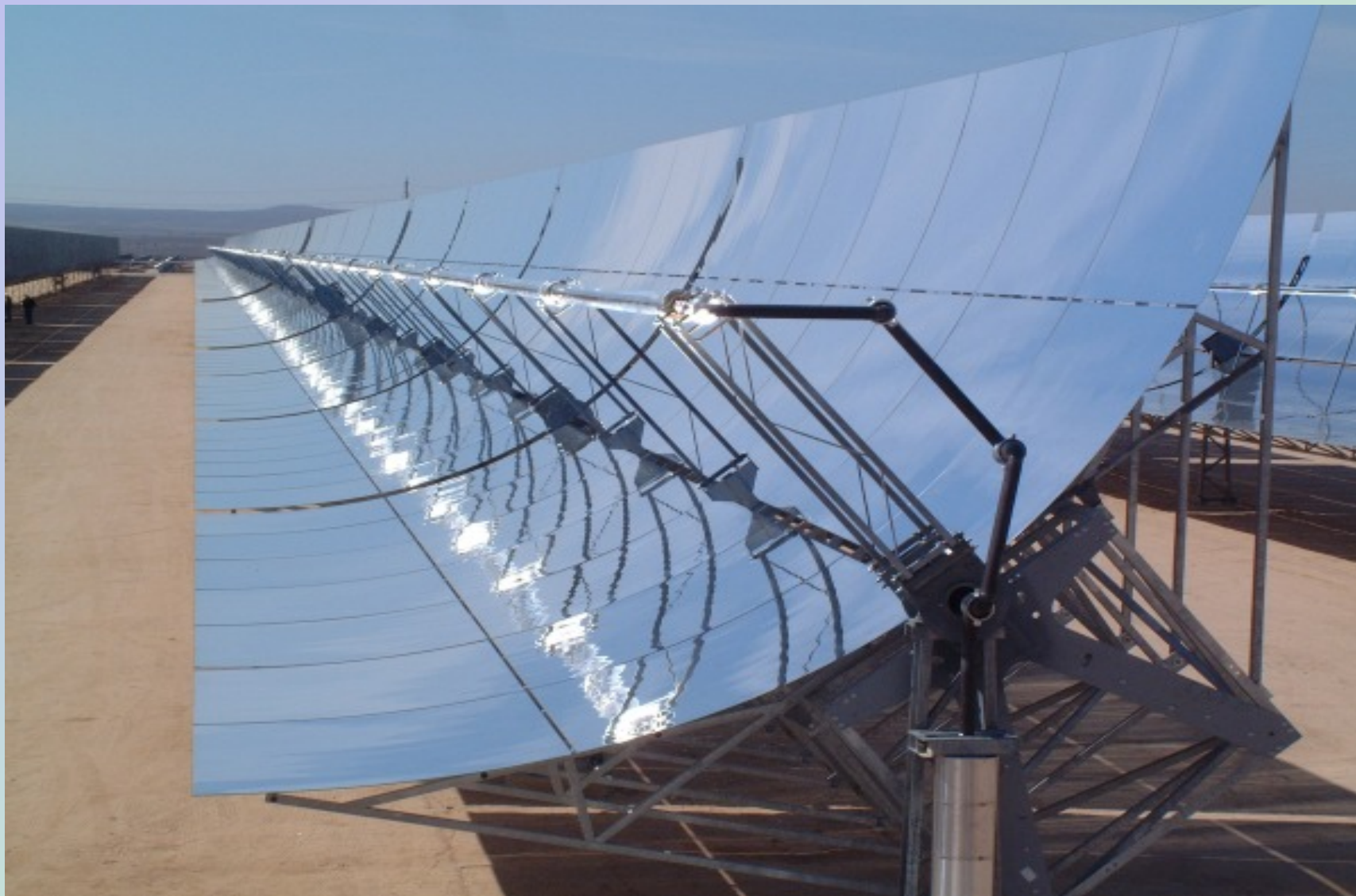
2 x 50 MW fully developed, 5 x 50 MW under development, financial closure of first 50 MW plant expected in spring 06, second to follow late 2006

2002/3: Largest new Demo trough since 1990 (1 MWe)

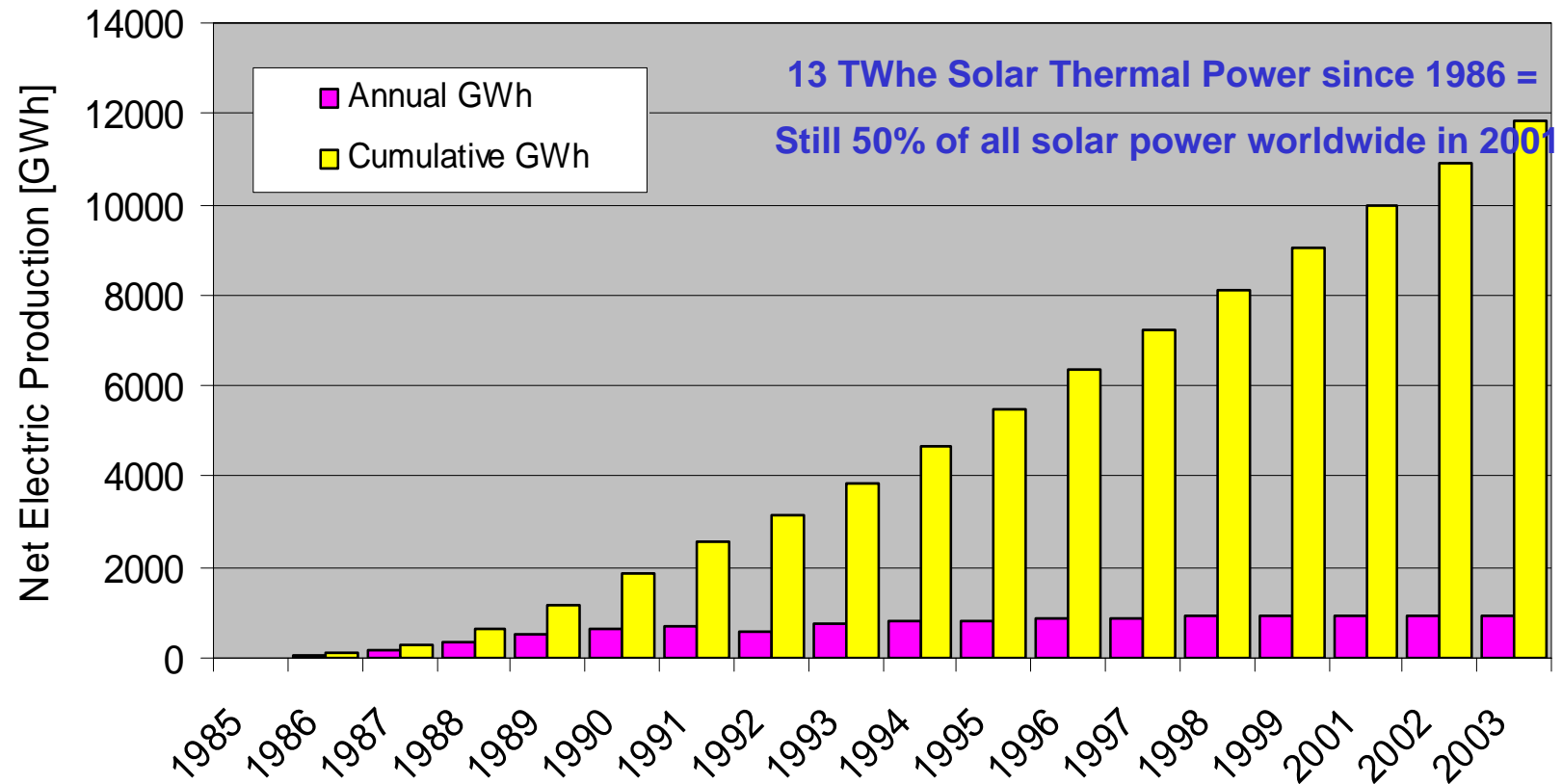
built in full cooperation with KJC in CA



Erection of 50,000 sqft = 1 MW SKALET Loop at Kramer Jct.



Operating Status of Solar Thermal Power (all Parabolic Trough)



New Spanish Feed-In Law for CSP: Real Decreto 436/2004

MINISTERIO DE ECONOMÍA

5562 *REAL DECRETO 436/2004, de 12 de marzo, por el que se establece la metodología para la actualización y sistematización del régimen jurídico y económico de la actividad de producción de energía eléctrica en régimen especial.*

2. Resto de instalaciones de energía fotovoltaica del subgrupo b.1.1:

Tarifa: 300 por ciento durante los primeros 25 años desde su puesta en marcha y 240 por ciento a partir de entonces.

Prima: 250 por ciento durante los primeros 25 años desde su puesta en marcha y 200 por ciento a partir de entonces.

Incentivo: 10 por ciento.

3. Instalaciones de energía solar térmica del subgrupo b.1.2:

Tarifa: 300 por ciento durante los primeros 25 años desde su puesta en marcha y 240 por ciento a partir de entonces.

Prima: 250 por ciento durante los primeros 25 años desde su puesta en marcha y 200 por ciento a partir de entonces.

Incentivo: 10 por ciento.

- Grants same tariffs for PV and CSP from 100kW to 50MW
- Cost covering with up to 0.21Euro/kWh
- Bankable with 25 year guarantee
- Annual adaptation to electricity price escalation
- 12-15% natural gas backup allowed to grant dispatchability and firm capacity
- After implementation of first 500MW tariff will be revised for subsequent plants to achieve further cost reductions

The Spanish Market – Market Pull through Feed-In Law => 800 MWe

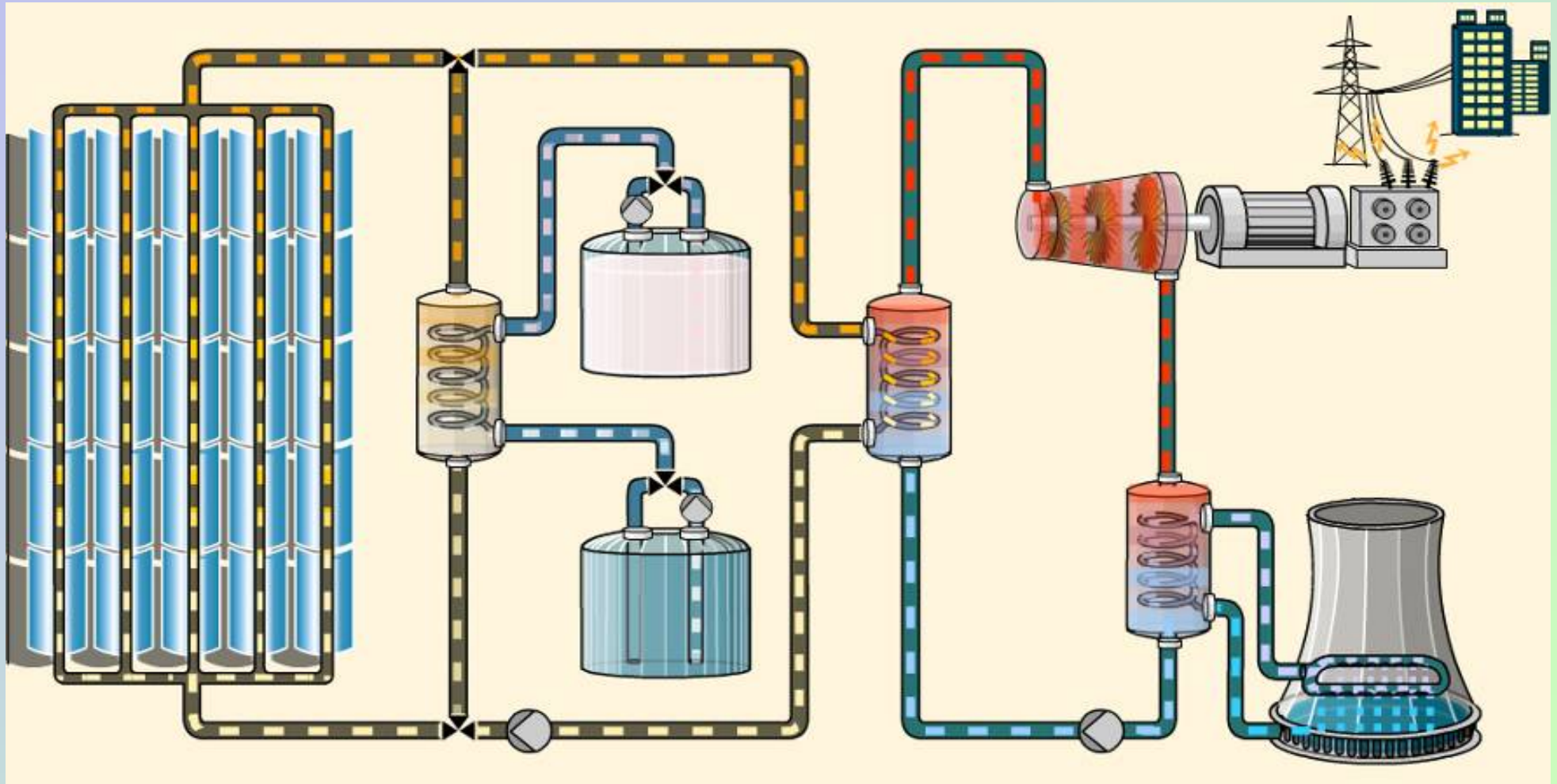


The AndaSol Projects

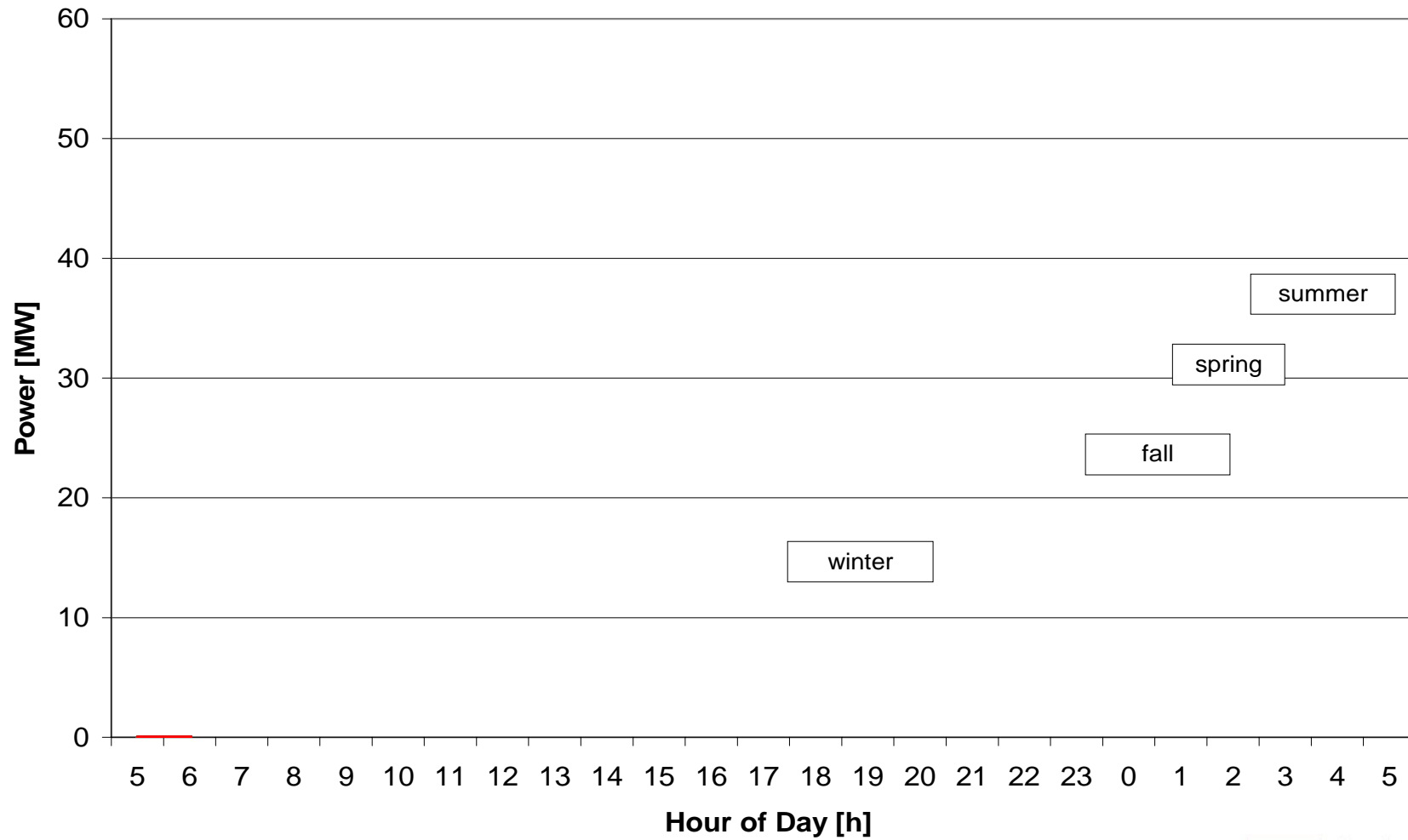


- Technology: **Parabolic Trough with SKAL ET Design**
- Capacity: **4 x 49.9 MW_{el}**
- Storage: **Molten salt storage for 7.5 – 12 full load hours = 3,600 – 5,000 h/yr**
- Project Site: **Plateau of Guadix, Province Granada**
- Net electricity production:
2 x 180 / 2 x 250 mn kWh/a
- Investment: **2 x €250 / 2 x €320 mn**

AndaSol Functional Diagram



AndaSol Seasonal Operation



The Absolute „Musts“ for a Successful CSP Market Introduction

- As CSP projects are much bigger in single project size **as most other renewable power projects and, thus, have investment volumes from €/\$ 100 to more than €/\$ 500 million, even with well - proven technology such as Parabolic trough technology:**
- the project **must be fully guaranteed by one, single EPC contractor**
- that **EPC contractor must be bankable, i.e. he is good enough for 20% LD's**
- The good message: if this bankability is given, **financing is not at all a problem: In Spain, there are about 15 internationally operating banks** keen to get a share of the financing cake of **€8 billion!**
- **This requires a stable, long-term regulatory framework:** with given long lead times for CSP projects (as with any other big conventional power plant) **ITC's and PTC's have to consider this longer lead times of at least 4-5 years**
- **These incentives have to be consistent** – as long as one new instrument (e.g. the Federal Solar ITC) is just implemented while others are skipped at the same time, no investor will trust this environment

The CSP Industry Commitment

- Today, concentrated solar thermal power (CSP) is competitive with either:
 - fossil fuel prices of \$ 60 per barrel of crude oil or \$ 12/mmbtu of gas (if fuel supply contracts are reflecting this level long-term)
 - or with tariffs of \$ 0.19/ kWhe in solar - only or, \$ 0.15/ kWhe in hybrid mode (25% gas share + Mojave desert solar radiation conditions)
- **CSP Industry doesn't need subsidies** beyond a market introduction phase of 2-3GW if we would get a long-term, fair compensation for clean and dispatchable peaking power!
- Regulation should support long-term PPA's (25 - 30 years)
- This would be a strategic, consistent industry and environmental policy programme – American and European CSP companies are ready to join forces to reduce dependency on oil and gas
- What does the CSP industry offer:
 - Firm, dispatchable peaking power – significantly reducing dependency on gas peaking plants
 - Reliable technology, reducing fossil fuels up to 100% through use of thermal storages w/o need of any back-up capacity
 - Utility-scale and proven technology, perfectly fitting into the utility's expansion plans
 - Much more jobs than building conventional power stations as solar field investments (50% of total investment) cause labour-intensive construction & erection

Partners of AndaSol-1 and AndaSol-2

Solar Millennium AG / Milenio Solar

Desarrollo de Proyectos SL

- Has collected € 15 million private risk capital for solar thermal project development
- Develops solar thermal projects in Spain, Greece (Island of Crete), Southern Mediterranean countries and the Southwest of the USA
- Raises equity for these projects
- Has designed, procured, constructed and operated a 1 MWe test loop of innovative SKAL-ET parabolic trough collectors of 800m length and over 4.300 m² at SEGS V plant
- Its 100% technology subsidiary, Flagsol GmbH, is world leader in design and engineering of parabolic trough solar fields

ACS Group / Cobra Group

Biomass Power Plants

- Planta de 16 MW "Energías de la Mancha (Ciudad Real)
- Planta de 14,2 MW La Loma (Jaen)
- Planta de 5,93 MW Cuellar (Segovia)

Solar Power Plants

- Planta de 98 kW Fotovoltaica en Sa Rapita (Mallorca)
- Planta Fotovoltaica en Tres Cantos (Madrid)

Wind Parks

- TRUCAFORT: 29,85 MW, Provincia de Tarragona
- MONTE DA SERRA: 14,4 MW, Provincia de A Coruña
- MONTE MARBAN: 11,4 MW, Provincia de A Coruña
- VILLALBESA: 22,2 MW, Provincia de A Coruña
- MONTE REDONDO: 49,5 MW, Provincia de A Coruña
- REQUEIXO: 10,5 MW, Provincia de A Coruña
- OUTES: 33,6 MW, provincia de A Coruña
- RAPOSERAS: 39 MW, Provincia de Logroño

Combined Cycles

- Castellon 800MW para IBERDROLA (terminada 2002)
- Castejón 400 MW para IBERDROLA (terminada 2003)
- Santurce 400 MW para IBERDROLA (en construcción)
- Amorebieta 800 MW para ESB (en construcción)
- Escombreras 800 MW para IBERDROLA (Permisos)
- Sabon 400 MW para UNION FENOSA (Permisos)
- Aceca 400 MW para UNION FENOSA (Permisos)

